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Feasibility of electrochemical oxidation process for treatment of saline wastewater

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Abstract

Background: High concentration of salt makes biological treatment impossible due to bacterial plasmolysis. The present research studies the process of electrochemical oxidation efficiency and optimal levels as important factors affecting pH, salt concentration, reaction time and applied voltage.

Methods: The sample included graphite electrodes with specifications of 2.5 cm diameter and 15 cm height using a reactor with an optimum capacity of 1 L. Sixty samples were obtained with the aid of the experiments carried out in triplicates for each factor at 5 different levels. The entire experiments were performed based on standard methods for water and waste water treatments.

Results: Analysis of variance carried out on effect of pH, salt concentration, reaction time and flow intensity in elimination of chemical oxygen demand (COD) showed that they are significant factors affecting this process and reduce COD with a coefficient interval of 95% and test power of 80%. Scheffe test showed that at optimal level, a reaction time of 1 hour, 10 g/L concentration, pH = 9 and 15 V electrical potential difference were obtained.

Conclusion: Waste waters containing salt may contribute to the electro-oxidation process due to its cations and anions. Therefore, the process of electrochemical oxidation with graphite electrodes could be a proper strategy for the treatment of saline wastewater where biological treatment is not possible.

Keywords: Saline wastewater, Graphite electrode, Salinity removal, Electrochemical oxidation.

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Introduction

Saline wastewater contains high amounts of organic compounds and soluble inorganic salts which are produced from industries such as fish processing, sea food packing, tanning and petrochemicals (1). In biological treatment of wastewaters with high salt concentrations especially in the of aerobic activated sludge phase process, the efficiency of decontamination would be very low due to bacterial plasmolysis in high concentration of salt (over 1%) (2,3). Desalination is required before treatment process. Therefore, to treat the waste waters containing total dissolved solids (TDS), other advanced treatment methods such as ultra-filtration (4), nano-filtration (5), reverse osmosis (6), electro-Fenton processes (7), and photochemical electrodialysis (8) have been studied.

In the methods of membrane filtration of saline wastewaters where some solution is used for demineralization, the influent organic matter to the membrane should be zero level (9). Waste waters containing high salt appeared to have high electrical conductivity due to high concentration of cations and anions. Hence, this seems to be an appropriate method in combination with electrochemical methods in the treatment of such waste waters (10).

Many studies have been conducted on electro oxidation of organic compounds where various materials are used as anode. This method has been successfully employed in the treatment of wastewaters from industries such as textile, tanning, distillation and leachate industries as well as urban wastewater. Different anodes have been employed for the treatment of industrial wastewaters. Recently, electrode graphite has been widely used for the decomposition of organic matter because it is economical. Graphite has a large surface area; this feature enables it to increase the rate of organic matter removal through adsorption and electro-oxidation. These electrodes are more efficient compared with other electrodes. Hydroxyl radicals are dominant because of the physical adsorption of oxygen on to the graphite electrode where they cause com-